DELAWARE NONPOINT SOURCE PROGRAM 2016 ANNUAL REPORT

DELAWARE DEPARTMENT OF NATURAL RESOURCES
AND ENVIRONMENTAL CONTROL

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The Delaware Nonpoint Source Program administers a competitive grant made possible through Section 319 of the Clean Water Act. The grant provides funding for projects designed to reduce nonpoint source (NPS) pollution in Delaware. NPS pollution may be defined as any pollution that originates from a diffuse source (such as an open field or a road) and is transported to surface or ground waters through leaching or runoff. Reduction of NPS pollution may often be achieved through incorporation of specific best management practices (BMPs) into project workplans. Projects may target any source of NPS pollution, but most frequently involve agriculture, silviculture, construction, marinas, septic systems, and hydromodification activities.

In addition to funding projects that achieve reductions in NPS pollution, the Delaware NPS Program is committed to addressing the issue through educational programs, publications, and partnerships with other organizations working to reduce NPS pollution in Delaware.

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Preface

The 2016 Delaware NPS Report is developed by the Delaware Department of Natural Resources and Environmental Control (DNREC) to meet a grant condition that appears in each annual 319(h) Grant award to the State of Delaware from the US Environmental Protection Agency. This programmatic condition in the award states, the report shall contain the following:

- A brief summary of progress in meeting the schedule of milestones in the approved Management Program, and,
- Reductions in nonpoint source pollutant loading and improvements in water quality that has resulted from implementation of the Management Program.
- Descriptions of priority Watershed Based Plan accomplishments. Accomplishments should be based on the implementation milestone goals/objectives as identified in each priority plan. The goal information can be displayed in the form of a watershed goal/accomplishment chart showing percent achieved, supplemented by a short narrative that should give the reader a clear understanding of the actions being taken and the outputs and outcomes which are occurring from the actions. If monitoring was completed, a summary of that information should also be included. For example, if 1000 feet of streambank stabilization was completed, then how does that compare to the needs identified in the watershed based plan i.e. what percent of streambank stabilization was completed compared to the overall needs as identified by the plan. Similar comparisons should also be provided for each significant pollutant load reduction

What is Nonpoint Source Pollution?

Nonpoint source (NPS) pollution is defined as polluted stormwater runoff associated with rainfall, snowmelt or irrigation water moving over and through the ground. As this water moves, it picks up and carries pollutants with it, such as sediments, nutrients, toxics, and pathogens. These pollutants eventually reach lakes, rivers, wetlands, coastal waters and ground waters of Delaware

NPS pollution is associated with a variety of activities on the land including farming, logging, urban/construction runoff, onsite sewage systems, streambank degradation, shore erosion and others. For example, stormwater flowing off the land carries the nutrients nitrogen and phosphorus into local streams, rivers and ponds. Under natural conditions, this is beneficial up to a point. However, if excessive nutrients enter these water bodies they cause nuisance algae blooms, then these nutrients are deemed pollutants.

The pollution contributed by nonpoint sources is the main reason why many of Delaware's waters are considered "impaired." Impaired waters are those waters that do not meet Water Quality Standards for designated uses (e.g., fishing, swimming, drinking water, shellfish harvesting, etc.). Progress in managing NPS pollution in Delaware is represented in this report. It was produced by the Department of Natural Resources and Environmental Control (DNREC) – NPS Program to meet Clean Water Act, Section 319(h) Grant conditions and to demonstrate consistency with three essential elements:

1. EPA Strategic Plan Goal 2 – Protecting America's Waters
2. EPA Strategic Objective 2.2 – Protect and Restore Watersheds and Aquatic Ecosystems
3. Work plan commitments plus time frame (overall progress is reported in this document)

I. The Delaware NPS Program

As part of the DNREC, the Delaware NPS Program is committed to addressing the issue of nonpoint sources pollution as it affects Delaware's numerous waterbodies. Efforts include grant funding, education, outreach, and partnerships with other organizations working together to reduce nonpoint source pollution in Delaware.

II. NPS Program Funding

Nonpoint Source (NPS) pollution constitutes the nation's largest source of water quality problems. Approximately 40 percent of the United States Rivers, lakes, and estuaries surveyed to date are not clean enough to meet basic uses such as fishing or swimming due to NPS pollution.

To counter the ever expanding NPS problem, Congress established the NPS Pollution Management Program under Section 319 of the Clean Water Act (CWA) in 1987. This program provides states with grants to implement NPS pollution controls to achieve goals that are described in NPS pollution management program plans.

On August 4, 1988, Delaware's original (NPS) Program was approved by the Environmental Protection Agency (EPA) making it one of the first programs in the nation to comply with Section 319 of the CWA. Using CWA Section 319 funding, Delaware's NPS Program administers a competitive grant program. The grant provides funding for projects designed to reduce NPS pollution in Delaware's impaired waterbodies. Reduction of NPS pollution is most often achieved through incorporation of specific best management practices (BMPs) into project workplans. Whenever possible, funds are focused in sub-watersheds where NPS control activities are likely to have the greatest positive impact. Funded restoration activities are implemented using the most effective measures and practices available in order to achieve water quality improvements. Eligible types of management program implementation activities include the following:

- Non-regulatory NPS reduction programs
- Technical assistance
- Financial assistance
- Education
- Training
- Technology transfer
- Demonstration projects

Proposals are requested annually, reviewed, evaluated and prioritized, and those which are

determined to meet specified requirements are eligible for funding. At least 40 percent of the overall project cost must be represented by non-federal matching funds.

III. Delaware NPS Issues

More than 90 percent of Delaware's waterways are considered impaired. The state's list of impaired waters, filed with the EPA, includes 377 bodies of water that suffer from 11 different impairments, the most common of which are NPS related pollutants including pathogens and nutrients (nitrogen and phosphorus). Most impairments come from nonpoint sources, which are harder to control. As Delaware is a groundwater driven state, removing NPS pollutants become an even harder problem to solve. Due to the rate of groundwater travel through the system, many NPS pollutants entering the systems up to 30 years ago are just now entering surface water bodies today. As such, the effectiveness of current agricultural BMPs will not be realized until much further in the future.

"Impaired waters" are polluted waters. More technically, they are waters that do not meet water-quality standards for their designated uses, such as recreation, fishing, or drinking. Impaired waters could be suffering from excess nutrients, low dissolved oxygen, toxins, bacteria, heat, or any combination of these problems.

Reduction of nonpoint sources of pollution is achieved through the incorporation or installation of specific best management practices (BMPs) addressing agriculture, silviculture, construction, septic systems, and hydromodification activities. To encourage and support the BMP installation, the NPS Program administers a competitive grant program currently made possible through Section 319 of the Clean Water Act. While this federal financial support has proven successful in complementing Delaware's NPS efforts, the NPS Program is currently seeking additional finances to expand our activities to more systematically address Delaware's NPS concerns.

Additional roles and responsibilities of the NPS Program include geospatial BMP tracking and reporting, management of the agricultural State Revolving Fund Program, support for developing Pollution Control Strategies, and watershed plan development and/or coordination.

IV. Vision and Mission

The Department of Natural Resources and Environmental Control envisions a Delaware that offers a healthy environment where people include a commitment to the protection, enhancement and enjoyment of the environment in their daily lives; where Delawareans' stewardship of natural resources ensures the sustainability of these resources for the appreciation and enjoyment of future generations; and where people recognize that a healthy environment and a strong economy support one another.

It's the mission of the Delaware Department of Natural Resources and Environmental Control to protect and manage the state's vital natural resources, protect public health and safety, provide quality outdoor recreation and to serve and educate the citizens of the First State about the wise use, conservation and enhancement of Delaware's Environment.

The Nonpoint Source Management Program is a dynamic and open-ended program intended to facilitate and promote statewide efforts to manage nonpoint source pollution. The following priorities will guide this program:

1. The NPS Program will support the identification and quantification of those problems that are caused specifically by nonpoint source pollution through assessment updates.
2. The NPS Program will be implemented and updated to realistically reduce nonpoint source pollution in a cost-effective manner.
3. The NPS Program will address nonpoint source pollution through a program that balances education, research, technical assistance, financial incentives, and regulation.
4. The NPS Program will follow a non-degradation policy in areas where surface and ground waters meet state water quality standards and a policy to realistically improve water quality in areas that do not meet these standards.
5. The NPS Program will continue to use the coordinated approach for implementation and maintain an open ended framework to incorporate new initiatives and support interactive approaches based on the effectiveness of existing policies and implementation mechanisms.
6. The NPS Program will support the development and implementation of Watershed Restoration Action Strategies (WRAS)/Pollution Control Strategies (PCS) for watersheds of identified impaired or threatened waters in accordance with the Unified Watershed Assessment List.

In Delaware, the lead agency for the development and implementation of the Nonpoint Source (NPS) 319 Program is the Department of Natural Resources and Environmental Control (DNREC), Division of Watershed Stewardship.

V. Executive Summary

The Delaware Nonpoint Source Program has focused this annual report on six priority watersheds in Delaware - Chesapeake, Christina Basin, Appoquinimink River, Broadkill River, Inland Bays, and St. Jones River - comprising 1,525 square miles. All suffer from impairments linked to nonpoint source water pollution.

In 2016, the Delaware NPS Program received $1,907,844, in federal section 319(h) grant funds to focus on nonpoint source water pollution reduction efforts. This annual report documents the activities and highlights of the State of Delaware, Department of Natural Resources and Environmental Control's (DNREC) Nonpoint Source (NPS) Program during the 2016 calendar year. It also fulfills the requirements of Section 319 of the federal Clean Water Act. DNREC's NPS Program annually prepares this report to inform stakeholders on the state's progress in the area of nonpoint source water pollution reduction. Although this report should not be considered a complete enumeration of all nonpoint source pollution reduction activities, it describes the most important features and accomplishments of the NPS Program.

In 2016, the Delaware NPS Program continued to reduce water pollutant levels by achieving milestone targets. Milestone targets are near-term or long-term commitments that promote a steady pace of progress towards water quality improvement. This report identifies several accomplishments during the 2016 calendar year that helped Delaware achieve long-term and short-term milestones (Appendix C), all of which have been identified in the State's NPS Management Program. Milestone activities successfully implemented during 2016 to support and/or enhance the program include: providing grant funding, education and outreach, and enhancing partnerships with other organizations to work together to reduce nonpoint source pollution in Delaware.

- **Grant funding** – In 2016, the Delaware NPS Program received $1,907,844, in federal section 319(h) grant funds to focus on nonpoint source pollution reduction efforts. Grant funding was used and leveraged to implement pollutant control projects, best management practices, and actions featured in the table below.

- **Education and Outreach** – On March 24, Delaware's NPS Program held the biennial meeting of the Delaware Nonpoint Source Advisory Committee Meeting in Lewes. Over 60 participants attended the daylong meeting which featured presentations from all areas of the state and sectors including both agriculture and urban. The day highlighted many projects funded by the NPS Program and described in this report.

- **Partnerships** – Key best management practices, like cover crops, increased significantly due to the Delaware Soil Health Partnership, which focused on increased NRCS practices through innovative programs and utilizing funds through the Regional Conservation Partnership Program and the National Water Quality Initiative. Due to the success of this partnership, Sussex County farmers experienced an increase in the implementation of cover crops of 12.9% (from 2015). Farmers, located in the Chesapeake Bay watershed, planted 4.6% more cover crop this year than last year. While farmers, located in the Inland Bays watershed planted 42.6% more cover crop this year than last year. The

increase in acres is attributed to the Soil Health Partnership's outreach efforts and decreased commodity prices.

Overall, the NPS Program funded projects that were completed during the calendar year resulting in pollutant load reductions of nitrogen at 1,971,886 pounds/year and phosphorus at 63,936 pounds/year (see table below). Delaware continues to ensure that projects funded with CWA Section 319 dollars make progress towards restoring or protecting waters impaired by nonpoint source pollution.

Pollutant Controls, Practices, and Actions *** annual ǂcumulative**	**Unit**	**2016 Progress**
Cover Crop* (traditional and commodity)	acres	83,468
Nutrient Relocation* (net export from watershed)	tons	44,080
Nutrient Management*	acres	205,441
Tree Planting‡	acres	42
Rain Garden‡	structure	5
Stream Restoration‡	feet	7,902

VI. Watersheds

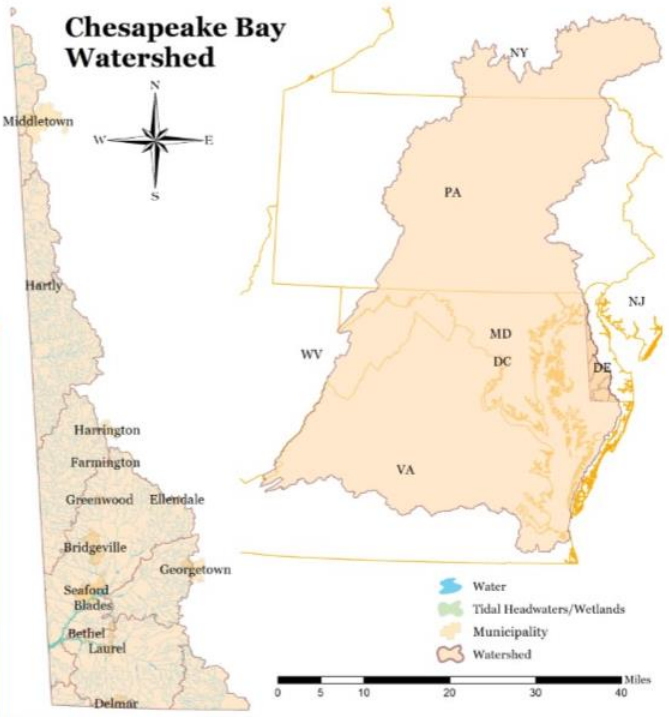
Delaware Nonpoint Source Program 2016 Watershed Progress Report

Chesapeake Bay Watershed

Watershed Description:

The Chesapeake Bay Watershed includes land area within Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. The portion of the Chesapeake Drainage within Delaware makes up about 1% of the land area within the entire Chesapeake Bay Watershed. The watersheds that make up the Chesapeake Drainage in Delaware encompass a 451,268 acre area of land in all three of Delaware's counties. The Chesapeake makes up approximately 10% of New Castle County, 33% of Kent County, and 50% of Sussex County.

The headwater streams and rivers that originate in Delaware all ultimately drain to the Eastern Shore of the Chesapeake. These streams include, from north to south: Elk Creek, Perch Creek, the C&D Canal, Bohemia Creek, Sassafras River, Chester River, Choptank River, Marshyhope Creek, Nanticoke River, Gum Branch, Gravelly Branch, Deep Creek, Broad Creek, Wicomico River, and Pocomoke River.



Water Quality Trends:

Total Phosphorus	Total Nitrogen	Total Suspended Solids

For more details see Appendix D at the end of the report.

BMP Progress FY 2016

BMP Name	Units	2016 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional and commodity)	Acres	67,137	Annual	36,809	182%	925,398	2,642
Nutrient Relocation (net export from watershed)	Tons	40,694	Annual	40,000	102%	245,698	16,012
Nutrient Management	Acres	174,387	Annual	163,500	107%	528,815	37,669
Hardwood Tree Planting	Acres	42	561	520	108%	1,446	110
Riparian Buffer (forest and vegetative)	Acres	0	2,493	2,542	98%		
Rain Garden	Acres	5	818	826	99%	75	3
Stream Restoration	Feet	7,502	9,621	1,600	601%	1,302	1,514
Wetland Restoration	Acres	7	2,724	2,652	103%	238	11
Total Reductions						1,702,734	57,950

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Chesapeake Bay Watershed

Goals: Current goals call for the increased implementation of numerous nonpoint source best management practices, especially in the agriculture sector (see below for a highlight of key numeric targets). The milestones allow jurisdictions the opportunity to adapt implementation strategies as necessary to meet the goals and achieve the TMDL standard. Delaware's milestone commitments are to annually reduce nitrogen by 3,429,386 pounds, phosphorus by 283,228 pounds and sediment by 60,605,240 pounds by the end of 2017, compared to the 2009 baseline.

Project Highlights:

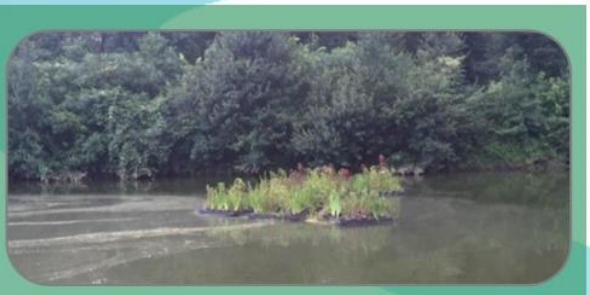
Nanticoke River Stream Restoration Project -

This project has been planned and designed to maintain approximately 4,342 linear feet of the Nanticoke River Tax Ditch using a natural channel design approach to restore drainage capacity, while creating stream bed habitat diversity and reducing bank erosion between Redden Road and Fawn Road east of Bridgeville, Sussex County, Delaware. This project was funded through multiple entities including EPA Chesapeake Bay Grant and 21st Century Funds. Construction on the project started the last week of December 2015 and was completed in the summer 2016. Monitoring will continue for 1 year post completion date. To date, the project has performed well in large storm events throughout the summer of 2016 and needed only minor repairs; however, additional follow-up is required to address the invasive species knotweed that is encroaching the project area. A tentative plan to add additional live stakes to the stream banks is planned for the spring 2017.

Nanticoke River Tax Ditch restoration.

Floating Treatment Wetland -

Floating wetlands are buoyant artificial rafts that float on a ponds surface and contain plants and media conducive for aquatic plant growth. This floating wetland was installed in July 2016 on a large farm outside of Clayton in Kent County. The pond is primarily used for irrigation; however, receives nutrients from nearby cropland. This wetland consisted of 4 floating rafts and native wetland vegetation. Funding for the project was from EPA Chesapeake Bay grants but NPS staff planted and installed the wetland.



Floating treatment wetland in Clayton, Kent County.

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Inland Bays

Watershed Description:

The Inland Bays/Atlantic Ocean Basin comprises approximately 313 square miles of eastern Sussex County, Delaware. Starting at Lewes and Cape Henlopen State Park at the southern edge of the entrance to Delaware Bay, the area extends southward approximately 24 miles along the Atlantic shoreline to the Maryland State Line. It includes the coastal towns of Rehoboth Beach, Dewey Beach, Bethany Beach, South Bethany Beach, and Fenwick Island. State Route 1 (SR 1) extends parallel to the shoreline and connects the towns.

The three inland bays are located just landward of the Atlantic Ocean shoreline. From north to south, these are Rehoboth Bay, Indian River Bay, and Little Assawoman Bay. Rehoboth Bay contains the Lewes-Rehoboth Canal and Rehoboth Bay Watershed; the Indian River Bay contains the Indian River, Iron Branch, and Indian River Bay Watersheds; and the Little Assawoman Bay contains the Little Assawoman, Assawoman, and Buntings Branch Watersheds.

Goals: Current goals call for the increased implementation of numerous nonpoint source best management practices, especially in the agriculture sector. The goals are those that were presented by Inland Bays Pollution Control Strategies (PCS) and an approved EPA watershed plan. The PCS involves many strategies to reduce nitrogen and phosphorous to meet the TMDL, but what is presented here are initiatives of the 319 program.

Water Quality Trends:

Total Phosphorus	Total Nitrogen	Total Suspended Solids
		

For more details see Appendix D at the end of the report.

Project Highlights:

Bio-enhancement to improve Estuarine Habitat and Water Quality of Poorly-Flushed Residential Canals -

Dead-end canals are common features of residential developments in the Inland Bays. They are generally poorly flushed, and the water has very long residence times. This leads to poor water quality, poor sediment quality, and low diversity in the biological community. Innovative solutions are sought for improving the water quality in these residential canals. Bulkheads provide opportune locations to explore how living or green shoreline restoration techniques can be applied to improve water quality. Techniques are being developed for installing oyster cages and floating treatment wetlands along bulkheads in dead-end canals to improve water quality and increase complex habitat for macro-invertebrate and fish communities. These practices would complement other land-based pollution control practices, offering a greater chance of success.

Floating oyster cages and treatment wetlands being used in dead-end canals to aid in water quality enhancement by Center for Inland Bays.

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Inland Bays

Project Highlights:

Siting Plan & Concept Designs for Living Shoreline Demonstration Projects in Delaware's Inland Bays -

The Center for the Inland Bays (CIB) has undertaken an initiative to maximize use of living shoreline stabilization techniques, in order to protect the water quality and habitat. An essential part of this initiative is the creation of publically accessible, local demonstration projects that can be used as tools for educating the public and marine contractors about living shoreline techniques and benefits.

The scope of the work includes identifying, assessing, and selecting potential living shoreline demonstration project locations, and then developing permit-level concept designs for up to six of these sites. The sites were identified and selected through a watershed-level analysis of potential locations, using a number of ecological and social parameters. Proximity to known state dredging areas also was considered, with a goal of identifying potential areas for beneficial reuse of sediments in living shoreline projects.

Example of a living shoreline.

BMP Progress FY 2016							
BMP Name	**Units**	**2016 Progress**	**Cumulative Progress**	**WIP Goal**	**% Achieved**	**Practice & N Load Reductions (lbs/year)**	**Practice & P Load Reductions (lbs/year)**
Cover Crop (traditional and commodity)	Acres	9,639	Annual	37,637	26%	456,381	377
Nutrient Relocation (net export from watershed)	Tons	2,358	Annual	20,909	11%	13,204	928
Nutrient Management	Acres	7,751	Annual	53,827	14%	21,799	1,674
Riparian Buffer (forest and vegetative)	Acres	0	209	3,235	6%		
Rain Garden	Structure	0	1	3	33%		
Wetland Restoration	Acres	0	29	4,175	1%		
Total Reductions						158,321	2,979

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Christina Basin

Watershed Description:

The Christina Basin is a 565 square mile basin contained in the larger Delaware River Basin. The Christina Basin, located in New Castle County in northern Delaware, includes four sub-watersheds:

- Brandywine Creek 325 sq. mi.
- Red Clay Creek 54 sq. mi.
- White Clay Creek 107 sq. mi.
- Christina River 78 sq. mi.

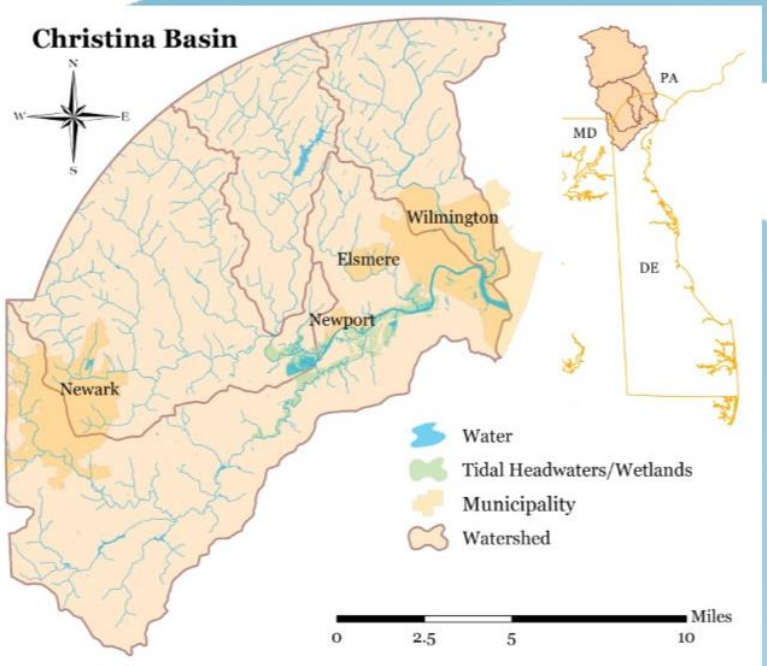
Although a small portion can be found within Maryland, the Christina Basin falls principally within two states, Pennsylvania to the north and Delaware to the south. The Pennsylvania portion is characterized by more open space, including agricultural land and forests, while the more urban, southerly portion in Delaware tends to have more built-up land.

The Watershed Implementation Plan development for the Christina Watershed was approved by EPA in the Spring of 2013.

Water Quality Trends:

Total Phosphorus	
Total Nitrogen	
Total Suspended Solids	

For more details see Appendix D at the end of the report.



Goals: Reduce pollutant loadings from current and future land use practices with an effort to achieve the TMDL through the efforts of numerous organizations and individuals. Delaware's efforts will be coordinated with the ongoing pollution reduction efforts in the Pennsylvania portion of the Christina Basin. The level of pollution reductions necessary to achieve the designated uses in the streams of the Delaware portion of the Christina Basin vary significantly. In some areas, bacteria levels need to be reduced as much as 95%, nitrogen levels as much as 50%, and phosphorus levels as much as 89%. In contrast, other areas of the Christina Basin are relatively free of excess nitrogen, phosphorus, and bacteria and simply need to be protected in their current state.

Partnership Efforts:

Limestone Presbyterian Church Rain Garden - The 1600 sq. ft. rain garden at the Limestone Presbyterian Church uses parking lot islands to drain 2.6 acres of paved and upland areas in the White Clay Creek Watershed. In 2016, volunteers participated in on the ground training held by Red Tail Restoration & Land Management to learn about invasive species removal, maintenance of the rain garden and plant identification in the rain garden. Red Tail Restoration & Land Management spent 22 hours assisting volunteers with maintenance concerns including weeding, mulching, transplanting and pruning. Costs for 2016 paid by the Nonpoint Source Program totaled $300 with Suez Water paying an additional $709.77 towards this project.

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Christina Basin

Project Highlights:

Finalization of Upper Christina Stream Restoration - Approximately 3,675 feet of stream was restored along the upper Christina River located west of Newark. These restoration efforts were implemented because of the severe bank erosion that was occurring along numerous properties adjacent to the stream channel. The banks were being undercut, causing mature trees to fall into the stream channel. Tremendous sediment loads were being released into the waterway with every storm event, impairing habitat and creating high turbidity conditions in the water column.

Restoration efforts along a tributary of the upper Christina River north of Hidden Valley Park which helped save a home that was being threatened by an eroding stream bank.

Before and after construction photos along the Upper Christina River as part of Phase I. Banks were stabilized with boulder walls and root wads (1b.). A cross-vane was installed (2b.) in the channel to prevent down-cutting and to direct the water toward the center of the channel during high-flow storm events.

Beginning in 2010, several property owners residing in the West Branch subdivision contacted the Division of Watershed Stewardship and expressed their concerns about the loss of trees and property with no apparent end in sight. They requested assistance to rectify the problems exacerbated by upstream development and increased amounts of impervious surface throughout the watershed. Another restoration request was received in 2011 by a State Representative on behalf of a property owner who was experiencing severe stream bank erosion which, if not addressed, posed a threat to the dwelling.

The before and after of stream restoration/shoreline stabilization work that was completed for Phase II of the Upper Christina River Stream Restoration Project.

Implementation of the appropriate stream restoration techniques helped stabilize the stream banks, reducing sediment and nutrient loading, improving habitat and water quality, and allowing the channel to be resized for the flow volumes that pass through the systems during average storm events. Multiple restoration construction techniques, including bank-toe boulder protection and vegetative plantings were utilized to stabilize degraded stream banks and improve habitat and water quality and reduce the loss of property.

BMP Progress FY 2016

BMP Name	Units	2016 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional and commodity)	Acres	0	Annual	12.4	0		
Nutrient Management	Acres	1,105	Annual	7,559.0	15%	3,700	178
Rain Garden	Structure	0	36	31.6	113%		
Stream Restoration	Feet	400	3,675	0.0	-	69	63
Total Reductions						3,770	241

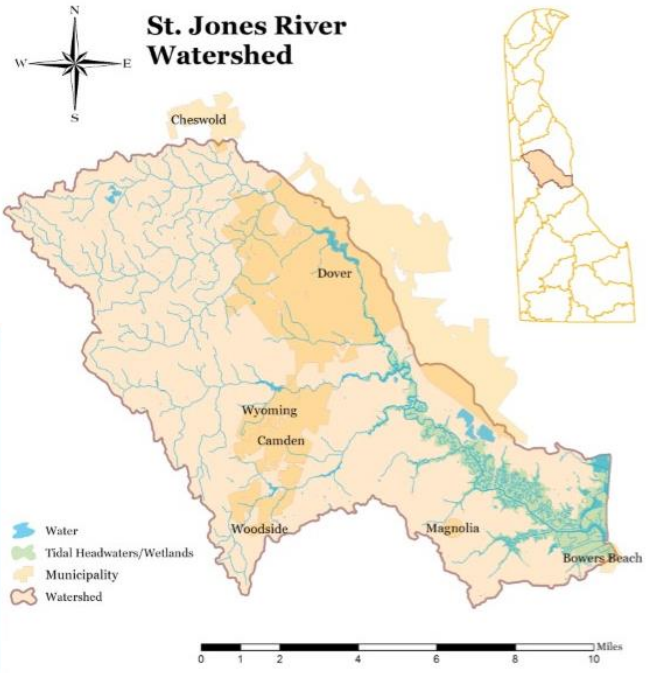
Delaware Nonpoint Source Program 2016 Watershed Progress Report

St. Jones River

Watershed Description:

The St. Jones River Watershed is approximately 25.9 square mile (16,576 acres) and is located in the central portion of Kent County. It drains 90 square miles of land. The major watercourse in the watershed is the St. Jones River which has its headwaters in the western part of the county, about 22 miles upstream from the Delaware Bay. Significant ponds in the watershed are Silver Lake, Moores Lake, and Wyoming Lake. Flat wetlands, usually forested, exist mostly in the upper portion of the watershed and eventually drain into creeks and streams. Nontidal riverine wetlands and tidal wetlands line the banks of the river, sometimes up to a $^{1}/_{2}$ mile wide toward the mouth of the river. Wetlands comprise 9,669 acres of the watershed and provide critical services such as nutrient removal, erosion control, habitat for plants and wildlife, flood reduction, and storm water storage to the citizens of Delaware.

The St. Jones Watershed has 5,236 acres of protected lands with the St. Jones River Reserve totaling approximately 3,750 acres.



Water Quality Trends:

Total Phosphorus	Total Nitrogen	Total Suspended Solids

For more details see Appendix D at the end of the report.

Goals: Limit pollutants to levels at or below the Total Maximum Daily Load (TMDL) values specified in the regulation, i.e., an overall reduction of nitrogen and phosphorus in the waterways by 40%, or 869.5 lbs per day for nitrogen and 63.4 pounds per day for phosphorus. Nonpoint sources, must reduce total nitrogen from 838.5 lbs per day and total phosphorus from 52.9 lbs per day. The TMDL also calls for 21.8 lbs per day reduction of nitrogen and 3.4 lbs per day from its stormwater (MS4) discharges. The designated uses for the St. Jones River include primary recreation, secondary recreation, fish, aquatic life and wildlife, industrial water supply, and agricultural water supply in freshwater segments.

Project Highlight: Turf can be significant sources of nutrients and the State of Delaware is actively working to decrease the amount of nutrients entering local waterbodies. During 2016, the NPS Program used methodologies established by the Chesapeake Stormwater Network and completed a Geographic Information System (GIS) analysis to identify grass lawns and turf areas that are a high risk for impairing water quality (darkest areas in the map are highest risk). Results will assist NPS efforts in conducting outreach and educating citizens on proper lawn care practices. In 2017, the NPS Program will work with the City of Dover's MS4 Program provide targeted outreach to those parcels identified as high risk through this analysis.

BMP Progress FY 2016

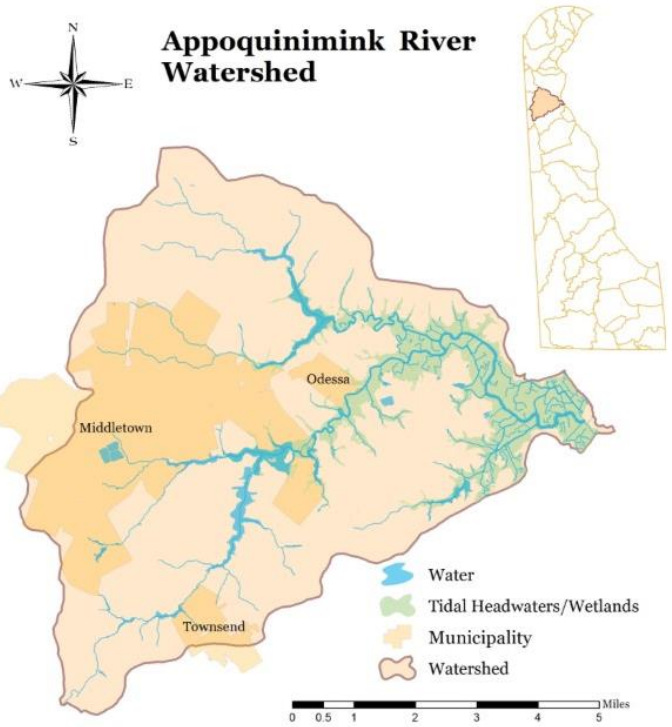
BMP Name	Units	2016 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional and commodity)	Acres	1,981	Annual	6,247	32%	6,074	7
Nutrient Management	Acres	2,729	Annual	21,588	13%	1,840	49
Total Reductions						11,066	261

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Appoquinimink River

Watershed Description:

The 16-mile Appoquinimink River meanders through farmlands and wetlands in southern New Castle County, draining 47 square miles. The headwater drains mostly agricultural lands, and feeds four major ponds. The tidal freshwater segment of the Appoquinimink is bound by the head of tide at Noxontown Pond and Silver Lake, and by Drawyers Creek's confluence with the Appoquinimink. The remainder of the watershed consists of a tidal marsh extending to the Delaware River. The Appoquinimink River system consists of five main tributaries, the Appoquinimink River main stem, Deep Creek, Dove Nest, Hangman's Run, and Drawyer Creek. There are several shallow, man-made small lakes and ponds in the watershed: Wiggins Mill Pond, Noxontown Pond, Silver Lake, and Shallcross Lake. The Appoquinimink River is tidal from the confluence with Delaware Bay to the dam at Noxontown Lake on the main stem, the dam at Silver Lake on Deep Creek, and the confluence with Drawyer Creek. Salinity intrusion from Delaware Bay typically reaches upstream past the Drawyer Creek confluence at river kilometer (Rkm) 8.5.



Goals:

Total Maximum Daily Loads (TMDLs) were established for the entire Appoquinimink River in December, 2003. These TMDLs called for a 60% reduction in nonpoint nitrogen and phosphorus loading. An implementation plan, or a Pollution Control Strategy, was to be developed by a Tributary Action Team, a diverse group of citizens and government agency personnel presented to the Department for promulgation to reach the prescribed TMDLs. Load reductions will be achieved through the implementation of BMP's in agriculture, development, wastewater, and private stewardship. The strategy is designed to reduce nutrient loadings from current and future land practices. This combination of actions will lead to the achievement of the TMDL.

Water Quality Trends:

Total Phosphorus	Total Nitrogen	Total Suspended Solids
		

For more details see Appendix D at the end of the report.

Progress Highlights:

All sectors have taken steps to improve water quality through the implementation of laws, regulations, and voluntary BMPs. Analysis using a basic land use loading rate model shows that, to date, nonpoint sources of TN and TP have been reduced by 109% and 111%, respectively, from the TMDL baseline levels. There is still a need for further reductions in areas that are currently lacking such as wastewater and stormwater.

BMP Progress FY 2016

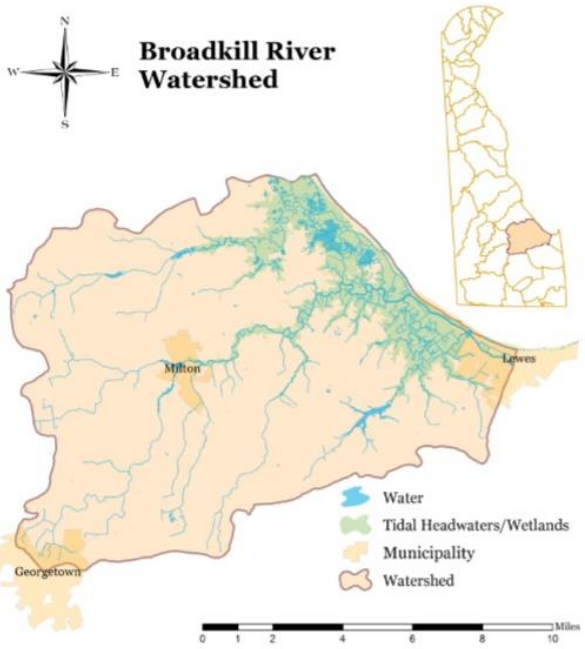
BMP Name	Units	2016 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional and commodity)	Acres	1,838	Annual	3,145	58%	27,991	54
Nutrient Management	Acres	5,803	Annual	12,854	46%	19,442	934
Riparian Buffer (forest and vegetative)	Acres		36	31.6	113%		
Total Reductions						47,433	988

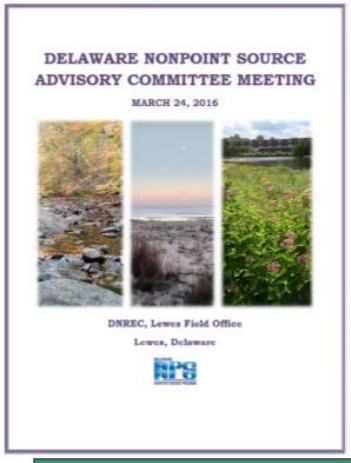
Delaware Nonpoint Source Program 2016 Watershed Progress Report

Broadkill River

Watershed Description:

The Broadkill River Watershed is located in the east central portion of Sussex County. It is bounded on the north by the Cedar Creek Watershed, on the west by the Gravelly Branch and Deep Creek Watersheds, on the south by the Lewes-Rehoboth Canal, Rehoboth Bay, and Indian River Watersheds, and on the east by the Delaware Bay. The mainstem of the Broadkill River is approximately 25 miles long. The major watercourse in this segment is the Broadkill River which originates at the Town of Milton and discharges into the Roosevelt Inlet near Lewes. Major impoundments in the area are Waggamons and Diamond ponds located near Milton. The Broadkill River flows generally eastward until it approaches the coast where it turns abruptly and flows south to discharge into the Roosevelt Inlet. The flow of this stream is sluggish and the water is turbid. The watershed drains an area of 107 square miles.





Project Highlight:

The Delaware NPS Program held a biennial advisory committee meeting on March 24, 2016. Fifty-five NPS partners and collaborators attended. Presentations ranged from living shoreline projects, agricultural projects (cropland transect survey, Conservation District initiatives to establish early cover crops, poultry best management practices), tax ditch drainage improvements, and educational opportunities for children with meaningful watershed experiences.

Goals: The established TMDL requires in terms of daily nonpoint nutrient loads, a 40% reduction in nitrogen (baseline 1,675 lbs/day) would require a reduction of 670 lbs/day to reach the target load. A 40% reduction in phosphorus (baseline 69.3 lbs/day) would require a 27.7 lbs/day reduction to reach the target load.

Water Quality Trends:

Total Phosphorus  Total Nitrogen  Total Suspended Solids 

For more details see Appendix D at the end of the report.

BMP Progress FY 2016

BMP Name	Units	2016 Progress	Cumulative Progress	WIP Goal	% Achieved	Practice & N Load Reductions (lbs/year)	Practice & P Load Reductions (lbs/year)
Cover Crop (traditional and commodity)	Acres	2,873	Annual			36,471	169
Nutrient Relocation (net export from watershed)	Tons	1,028	Annual	570	180%	5,716	607
Nutrient Management	Acres	2,283	Annual	79,420	3%	6,376	740
Hardwood Tree Planting	Acres	0	10.5				
Rain Garden	Structure	0	5.4				
Total Reductions						48,563	1,516

VII. Project Highlights

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Transect Survey

Project Highlights:

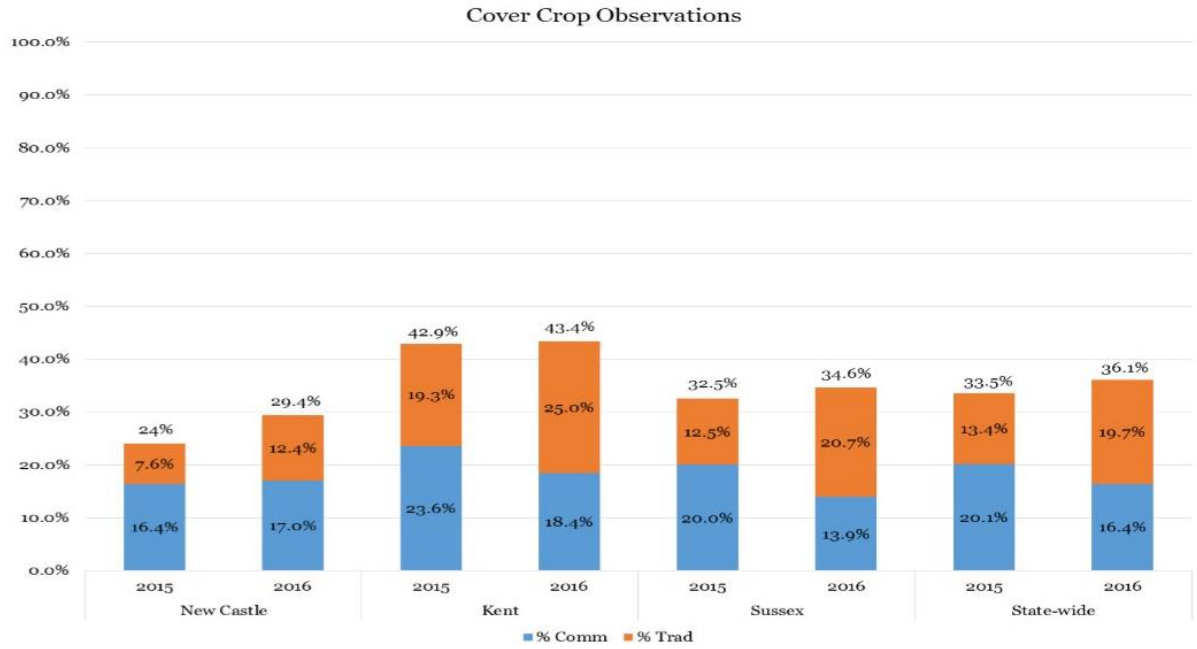
In 2013, Delaware began looking into ways to capture voluntary best management practices that were previously unaccounted for. The state became aware of a transect survey historically conducted by the Conservation Technology Information Center (CTIC) to collect cropland data.

Commodity wheat observed during survey in Kent County.

The survey was initially intended to collect conservation tillage practices, however, Delaware decided to enhance data collection efforts by collecting cover crop data in addition to conservation tillage.

Prior to adoption, DNREC worked closely with the state's agricultural partners including our Conservation Districts in each county, Natural Resource Conservation Service, Farm Service Agency, Delaware Department of Agriculture, and University of Delaware's Cooperative Extension, in order to determine if this survey would be beneficial to the state. We utilized the local knowledge from these partners to establish our driving routes through primarily agricultural crop land, as well as in the determination of when to conduct the surveys each year to match that of planting and growth patterns. Most importantly, our collaborators provided experienced staff to take part in the annual surveys.

Through the creation and implementation of Delaware's Cropland Transect Survey, Delaware has increased reporting of cover crop practices since 2015, providing the state with a supplemental source of data beyond what is collected from the conservation districts and other agricultural partners. The increased accuracy of reporting these practices helps in reaching our established practice implementation and nutrient reduction goals for the state. As seen in the chart below, the observation of cover crops in 2016 for each county has increased from the previous year's survey in 2015. The state-wide observation of cover crops through the survey has increased by 2.6%, bringing the average implementation of cover crops on agricultural lands to 36.1%.



Delaware Nonpoint Source Program
2016 Watershed Progress Report

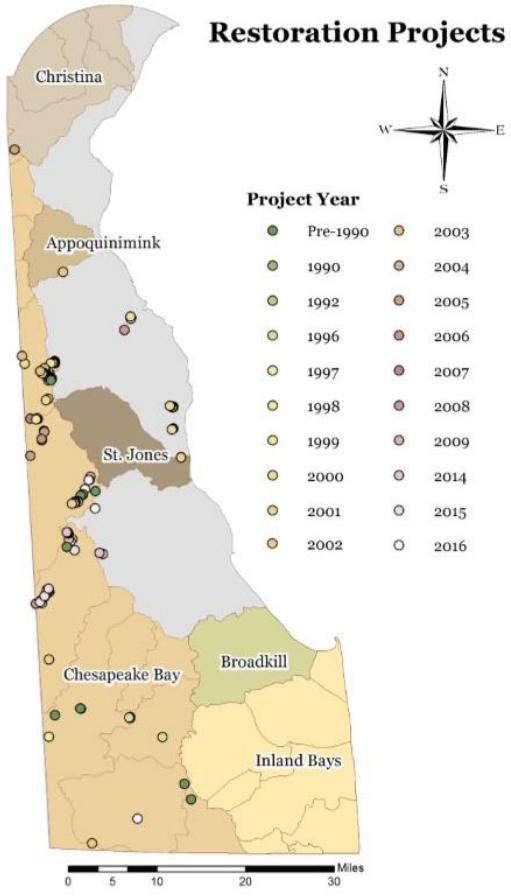
Wetland and Channel Restoration

Project Highlights:

As part of Delaware's Department of Natural Resources and Environmental Control's (DNREC) TMDL and Pollution Control Strategies, the Division of Watershed Stewardship has developed a program to educate the agricultural community and the general public on the importance of wetlands, streams, and riparian buffers in enhancing water quality on a long term basis. Implementing wetland and channel restoration projects is a primary goal to accomplishing this program. In 2016, four projects were implemented through this program.

Two water control structures (green points) were installed to enhance the previously installed frog-shaped wetland restoration project (yellow star).

Image of previously funded NPS project - Heron Drain. Footage was collected using unmanned aerial vehicle (UAV) technology.



Bartsch project – In March 2016, two water control structures were installed on Delaware Division of Fish and Wildlife property to treat approximately 52 acres. The project is located in the Choptank River watershed. This project was used to enhance another wetland restoration project that was previously installed.

Arvey project – The Arvey Project is a non-urban stream restoration project that was approximately 1,200' in length and is a tributary to the James Branch. The project is split into two different sections, one measuring 500' long and the other 700' long. It is located in the Broad Creek watershed.

DE F&W project – Approximately 30 PVC water control structures were installed in February 2016. The water control structures treated roughly 780 acres and were installed with the purpose of rehydrating previously ditched land. Immediately after the installation of the water control structures, plentiful waterfowl came back to the project site. This project is located in the Choptank River watershed and on property owned and managed by the Delaware Division of Fish and Wildlife.

HRUPSA project – In November 2016, a log structure was installed along the Horsepen Arm tax ditch, which eventually drains to the Marshyhope Creek. This project is located in the Marshyhope Creek watershed.

Matlack project – Two acres of wetlands were restored in November 2016. The land was previously unproductive agriculture land, but the soils were too wet for crops, so it was converted back into a wetland. The project is located in the Choptank River watershed.

Delaware Nonpoint Source Program 2016 Watershed Progress Report

Delaware Conservation Reserve and Enhancement Program (CREP)

Project Highlight:

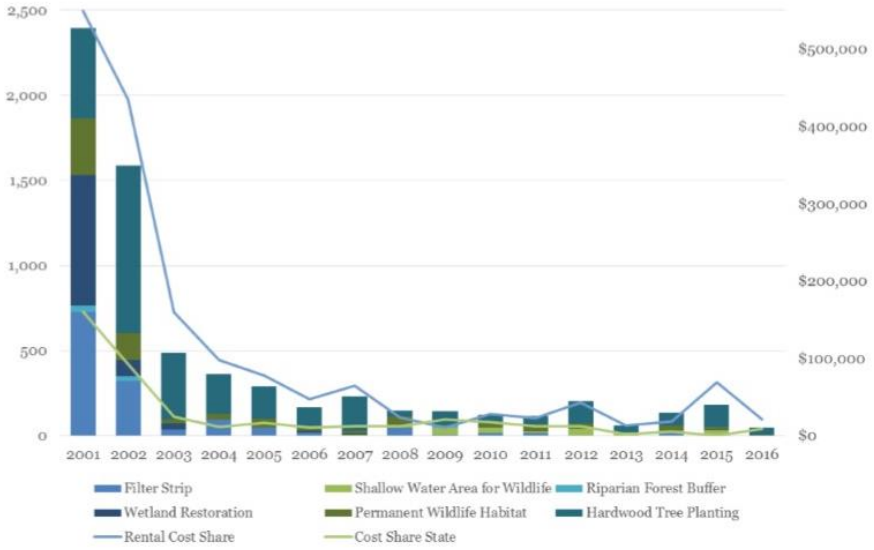
A 3 acre created wetland in Kent County, Delaware

The Delaware CREP Program was established in 1999 with the designated goals of improving water quality and enhancing wildlife habitat in the coastal plain geographic areas of the Delaware, Chesapeake, and Inland Bays watersheds. The program is a partnership between USDA Farm Service Agency and DNREC (managed by the NPS Program). The program is voluntary and incentive-based and pays farmers and landowners' attractive incentives for putting their least productive lands under a 10 or 15 year contract that requires the land to be put into the conservation practice the landowner chooses. Landowners can establish forest, native warm-season grasses, or cool season grasses. In return the landowner receives cost-share, annual rental payments, and generous bonus payments.

The State of Delaware and Delaware State Farm Service Agency Office worked closely with state legislators to reinstate the CREP Program into the 2016 State Budget. On July 1, 2016, Governor Jack Markell signed the Fiscal Year 2017 Final Operating budget for the State of Delaware. The balanced budget included $1M in funding for the Delaware CREP Program. As a result, a revised CREP agreement was developed. The agreement, signed on August 29, 2016, reinstates Delaware's CREP program and secures additional incentives for landowners living within the Chesapeake Bay watershed. Since the inception of the agreement, Delaware has made great strides to honor expiring contracts and DNREC can now begin to reinstate 2016 and 2017 expiring contracts (approximately 388 contracts) for 3,702 acres. Contract renewals will be for a 15 year term and will obligate a projected $983,507 of the $1M appropriated in the 2017 budget.

During 2016, a total of four new CREP contracts were enrolled totaling 48 acres. A total of 112 plans and contracts were developed for 1,180 acres. Approved for renewal in 2016 were 52 expiring CREP contracts totaling 1,090 acres. In addition, the CREP coordinator conducted 83 field spot checks in 2016, totaling 1,143 acres.

Cumulative CREP Program Activity 2001-2016



VIII. Load Reductions

In 2016, the Delaware NPS Program load reductions were calculated for many of the 319 funded projects implemented on a watershed scale. The load reductions are calculated using guidance established during the Pollution Control Strategy development process.

2016 Project Load Reductions/Year by Watershed

Project	Nitrogen (lbs)	Phosphorus (lbs)
Chesapeake Bay	1,702,734	57,950
St. Jones River	11,066	261
Inland Bays	158,321	2,979
Broadkill River	48,563	1,515
Appoquinimink River	47,433	988
Christina Basin	3,770	241
TOTAL	**1,971,886**	**63,936**

IX. Future Changes and Challenges

Delaware has developed this report to highlight accomplishments made, in 2016, to reduce nitrogen, phosphorus, and sediment pollution. The charts and tables above signify the continued progress in reducing loads to impaired watersheds. Additional commitments were made, between DNREC and EPA, with the development of annual milestones identified in Delaware's 2015 NPS Management Plan. These milestones describe the outcomes and key actions expected each year. The NPS Management Plan includes objectives that address nonpoint sources of surface water and ground water pollution as appropriate (including sources of drinking water) in alignment with the goals of the Clean Water Act. Objectives, of the plan, include both implementation steps and how results will be tracked (e.g., water quality improvements or load reductions). Additionally, long-term goals and short-term milestones are integrated with other key environmental and natural resource programs. NPS's program goals and objectives are periodically revised to reflect progress or problems encountered, develop strategies to make

progress towards achieving the goals, and develop indicators to measure progress. Updates to the NPS Milestones can be found in Appendix A.

Delaware continues to make progress to meet water quality goals with continued commitments of funding implementation activities to address the agriculture and urban sectors. For example, many of the key personnel working within the Districts help to write nutrient management plans, installing agriculture best management practices and helping farmers to identify resource concerns. Additional DNREC staff work with private landowners on buffers, wetland and stream restoration projects, septic system pump-outs, repair and/or replacement.

While we have missed some of our goals, Delaware has continued to make substantial progress and has invested significant effort into programmatic changes such as regulations, permits, and reorganizing programs. Although these additional efforts improve accountability, they do not have immediate input into nutrient reductions. Delaware's agricultural community works every day to conserve and protect our water resources, with many of our farmers implementing BMPs that are not accounted for or reported. We are now capturing that information through surveys and Chesapeake Bay related verification efforts. Funding for cover crop cost-share programs has increased participation and allowed us to increase cover crop acreages. We have exceeded our wetland restoration goals via targeted landowner contacts and funding in the Chesapeake Bay Basin, specifically the Nanticoke River Watershed. Additionally, in 2013, Delaware promulgated new On-Site Wastewater Regulations. The implementation of this new regulation is helping Delaware to meet future nutrient reduction goals for septic connections, pump-outs, and advanced treatment systems. Finally, in 2016, Delaware's NPS Program experienced a significant reorganization. This structural reorganization resulted in a consolidated NPS Program aligning the following programs - 319 NPS program, Chesapeake Bay Implementation Program, Conservation Reserve Enhancement Program and additional funding and resources through Delaware's Water Infrastructure Advisory Committee. In the future, the newly enhanced NPS Program will promote efficiency by centralizing and reducing data reporting requirements while increasing grant funding availability and leveraging capacity for federal grants and expand our partnerships.

Looking forward, Delaware's NPS Program will continue to make progress toward our goals and will work to align funding with water quality priorities. Although our state faces many challenges, we remain committed to working with our partners at the state, local and federal levels to reduce the levels of excess nutrients and sediments from entering our waterbodies.

X. List of Partner Organizations/Committee Members

The hard work and many hours of agency staff members, organization members and private individuals who have partnered with the NPS Program in 2016 to address, reduce, identify and/or measure NPS pollution in Delaware is greatly appreciated. This NPS pollution control and prevention program has been very active, well received and effective. It is a credit to our partners as they have cooperated in the face of many conflicts to make this program what it is today.

Partner Organizations
Center for the Inland Bays
City of Dover Planning Office
DDA Forest Service
DDA Nutrient Management Program
DE Department of Agriculture
DE Department of Transportation
Delaware Association of Conservation Districts
Delaware CREP Program
DNREC/Delaware Coastal Programs
DNREC/Drainage Program
DNREC/Fish&Wildlife
DNREC/Groundwater Discharges
DNREC/Sediment & Stormwater Program
DNREC/Shoreline and Waterway Management Program
DNREC/Solid Waste
DNREC/Water Resources
DNREC/Watershed Assessment and Management Section
DNREC/Wetlands & Subaqueous Lands
Farm Service Agency/State Office
Kent Conservation District
Nanticoke Watershed Alliance
New Castle Conservation District
NRCS State Office
Partnership for the Delaware Estuary
State of Delaware Planning Office
Sussex Conservation District
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
University of Delaware
University of Delaware Water Resources Agency
USDA/ Farm Service Agency
USDA/ Natural Resources Conservation Service

Appendix

Appendix A – 2016 Milestones

Appendix B – Annual Nutrient reductions for N & P

Appendix C – Annual Numeric Milestones

Appendix D – Water Quality Trend Data

Appendix A – 2016 Milestones

Delaware NPS Program Short, Mid and Long Term Milestones		
Short and Mid Term Milestones (2015 – 2019)	**Deliverable**	**2016 Comments/Status Updates**
Establish baseline conditions for program indicators	Program indicator baseline	Efforts are currently underway to develop a Department-wide compendium of Environmental Indicator (EI) data sets to communicate with the public. NPS staff have attended several EI meetings to discuss datasets that could be focused on for measuring the State's environmental conditions and status, and DNREC's performance.
Complete approval of all existing watershed plans	Watershed plans	COMPLETED
Complete baseline sampling for initial priority watersheds	Priority watershed baseline	NPS has reviewed current monitoring data and, in 2017, will determine baseline load reductions using current STORET data and loads identified in TMDLs.
Reduce nutrient loads from NPS sources in Delaware's priority watersheds.	Increase annual load reductions as funding allows	Nitrogen load reductions increased by 2% in 2016 (compared to 2015) in the St. Jones, Appoquinimink, and Christina watersheds. Phosphorus load reductions increased by 2% in 2016 (compared to 2015) in the Appoquinimink River watershed.
Establish baseline load reductions from BMP implementation	Establish baseline load reductions	NPS will evaluate watershed changes and evaluate load reductions, in 2017, for the following priority watersheds: Inland Bays, Little Assowoman Bay, St. Jones River Appoquinimink River, and Christina River

Increase number of outreach and education interactions	Increase number of outreach and education interactions by 10% over FY 2015 baseline	This goal was met, in 2016, through an outreach initiative relying on a variety of channels to deliver water quality messaging. These messaging outlets include the following but are not limited to printed/radio/TV advertising, events, workshops, presentations, programs, competitions, videos, webinar hosting's, websites, social media, email/newsletters, recreational opportunities and promotional materials.
Remove NPS related impairments from stream segments	one stream segment (2015) five stream segments (2019)	Success stories are identified annually to EPA. In 2016, NPS identified **Abbotts Mill Pond**.
Assess interim and 2015 milestone progress	Biennial milestone updates	Assessment ongoing.
Review and update plan as needed	Management plan update	Progress is ongoing. A complete plan will be provided to EPA in 2019.
Show relative progress towards BMP implementation activities for all the EPA approved watershed plans	Increase BMP implementation annually by watershed	In 2017, NPS will begin to evaluate A-I plans to demonstrate progress towards meeting BMP implementation goals.
Demonstrate water quality improvement in the priority watersheds resulting from plan implementation activities	303(d) de-listing	305(b) reports are prepared every even numbered year. Any water quality improvements would result in a 303(d) delisting. NPS will maintain delisting records and update annually.

Show a 10% decrease of pollutant loadings in 50% or more of the priority watersheds	Annual load reduction decreases	Ongoing - NPS continues to increase load reductions annually.
Show annual increases in funding and quantities of BMPs implemented in priority watersheds	Procurement of funds to close BMP implementation gaps	In 2016, NPS partnered with Sussex Conservation District, Kent Conservation District and Delaware Association of Conservation Districts on several NRCS Regional Conservation Partnership Program (RCPP) projects. These projects sought to implement water quality BMPs such as cover crops and poultry headquarter BMPs (like composters and manure sheds). Using RCPP funds, partners in the State have procured over $3M for water quality BMPs.
Remove one stream segment per year from the 303(d) list through 2019	Removal of 303(d) stream segment	303(d) assessments are found on DNREC's website - http://www.dnrec.delaware.gov/swc/wa/Pages/WatershedAssessment305band303dReports.aspx Draft 2016 delistings include; Lower Shellpot Creek (DO), Lower Brandywine (bacteria), Red Clay Mainstem (chlorinated pesticides), Mainstem Upper Christina River (PCBs, chlordane), Sewell Branch (bacteria), Upper Nanticoke River (bacteria), Deep Creek Branch (bacteria), Williams Pond (nutrients), Lower Broad Creek (bacteria), Stockley Branch (nutrients), Miller Creek (DO), Lower Army Creek (DO), Fork Branch (bacteria), Browns Branch (nutrients), Beaverdam Creek (DO), Upper Broadkill River (nutrients), Waples Pond (bacteria, nutrients)
Long Term Milestones (2019-2030)	**Deliverable**	**2016 Comments/Status Updates**
Complete BMP implementation for 75% of the EPA approved watershed plans	Increase BMP implementation by 75%	Progress ongoing.
Remove 50% or more of high priority TMDLs from 2010 303(d) list	Removal of half of high priority TMDLs from 303(d) list	Progress ongoing.

Appendix B – Annual Nutrient reductions for N & P

Nitrogen Load Reductions (lbs/year)	Chesapeake	St. Jones River	Inland Bays	Broadkill River	Appoquinimink River	Christina Basin	Total N (lbs/year)
Cover Crops	925,398	6,074	123,318	36,471	27,991	-	1,119,251
Nutrient Relocation	245,698	3,152	13,204	5,716	-	-	267,770
Nutrient Management	528,815	1,840	21,799	6,376	19,442	3,700	581,973
Tree Planting	1,446	-	-	-	-	-	1,446
Riparian Buffer	-	-	-	-		-	
Rain Gardens	75	-	-	-	-	-	75
Stream Restoration	1,302	-	-	-	-	69	1,371
Wetland Restoration	238	-	-	-	-	-	
Total N Reductions	**1,702,734**	**11,066**	**158,321**	**48,563**	**47,433**	**3,770**	**1,971,886**

Phosphorus Load Reductions (lbs/year)	Chesapeake	St. Jones River	Inland Bays	Broadkill River	Appoquinimink River	Christina Basin	Total P (lbs/year)
Cover Crops	2,642	7	377	169	54	-	3,248
Nutrient Relocation	16,012	205	928	607	-	-	17,752
Nutrient Management	37,669	49	1,674	740	934	178	41,245
Tree Planting	110	-	-	-	-	-	110
Riparian Buffer	-	-	-	-		-	
Rain Gardens	3	-	-	-	-	-	3
Stream Restoration	1,514	-	-	-	-	63	1,577
Wetland Restoration	11	-	-	-	-	-	
Total P Reductions	**57,950**	**261**	**2,979**	**1,515**	**988**	**241**	**63,936**

Appendix C – Annual Numeric Milestones

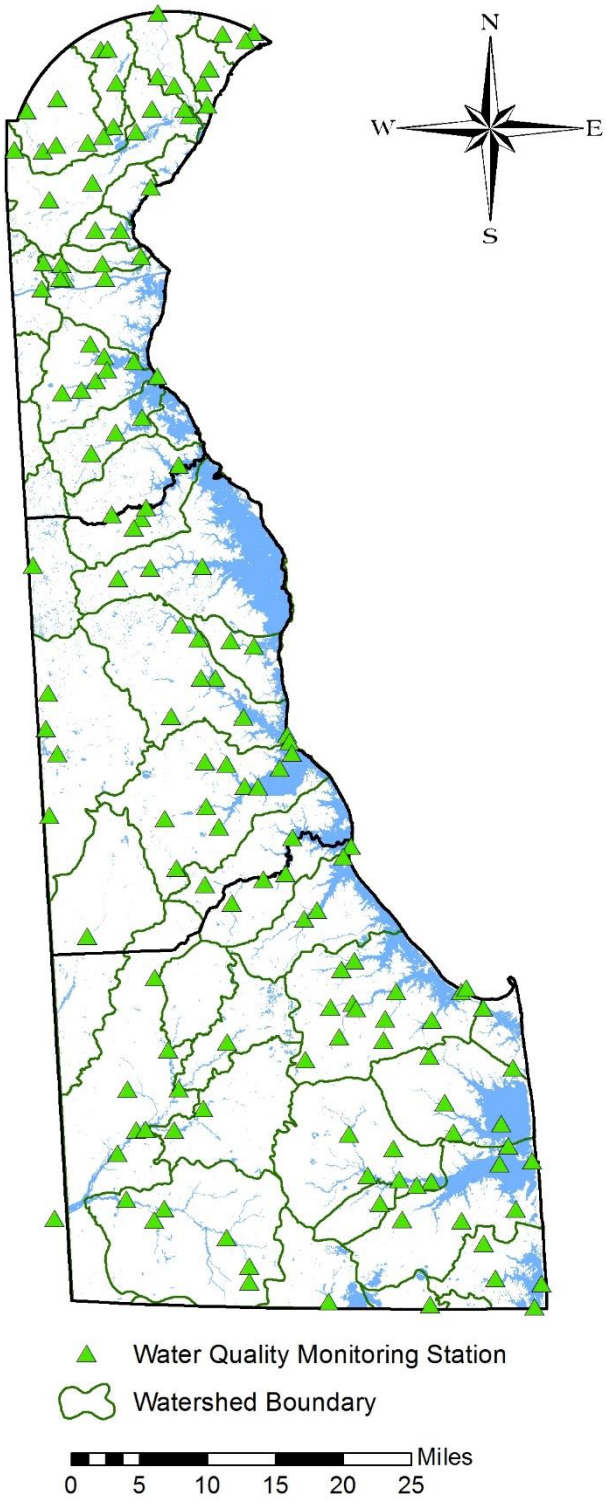
Pollutant Controls, Practices, and Actions (*annual, ǂcumulative)	Unit	2016 Progress	Chesapeake Bay	St. Jones River	Inland Bays	Broadkill River	Appoquinimink River	Christina Basin
Cover Crop* (traditional and commodity)	acres	83,468	67,137	1,981	9,639	2,873	1,838	0
Nutrient Relocation* (net export from watershed)	tons	44,080	40,694	0	2,358	1,028	0	0
Nutrient Management*	acres	205,441	174,387	2,729	7,751	2,283	5,803	1,105
Tree Planting‡	acres	42	42	0	0	0	0	0
Rain Garden‡	structure	5	5	0	0	0	0	0
Stream Restoration‡	feet	7,902	7,502	0		0	0	400

Appendix D – Water Quality Trend Data

Total nitrogen and total phosphorus data from 1999-2016 for all Delaware STORET stations was retrieved. Data from stations with 40 or more data points were analyzed using WQSTAT software to evaluate for concentration trends using non-parametric methods. 133 stations had 40 or more data points for total phosphorus and 132 stations for total nitrogen. The software reported statistically significant trends at various confidence levels depending on the type of statistical test used. For regulatory purposes the Department would not ordinarily consider 80 or 90 percent confidence levels as a trigger for further action. For this analysis, however, the lower confidence results are reported and mapped to aid in "telling the story", especially in the mapped data. See the tables and maps below.

Of the 133 stations evaluated for total phosphorus concentration trends, 45 had statistically significant trends. Trends were closely divided between upward and downward trends. 88 stations showed no trend, either positive or negative. Of the 132 stations evaluated for total nitrogen concentration trends, 76 stations had statistically significant trends and 56 stations had no trend upward or downwards. The vast majority of significant trends for total nitrogen were downward trends, mostly at higher confidence levels.

140 Stations were analyzed for trends in measured concentrations of total suspended solids for the 1998-2014 period of record. Of those 140 stations, sixty one stations had statistically significant trends. Of the sixty one stations with trends, six stations had statistically significant upward trends and the remaining fifty five stations showed downward trends. Seventy nine stations did not have statistically significant trends either upward or downward.



Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
101021	Naamans Creek	Naaman Creek @ State Line near Hickman Rd.	115	--	--	111	--	--	115	0.1322	98
101031	Naamans Creek	Naaman Creek S. Branch @ Darley Rd. (Rd. 207)	90	-0.052	98	90	--	--	90	-0.0851	95
101061	Naamans Creek	Naaman Creek South Branch @ Marsh Rd. (Rt. 3)	66	--	--	64	--	--	66	0	--
102041	Shellpot Creek	Shellpot Creek @ Hay Rd. (Rd. 501)	106	-0.052	98	104	--	--	106	-0.8908	95
102051	Shellpot Creek	Shellpot Creek @ Market St. (Rt. 13 Bus.)	95	--	--	93	--	--	95	0	--
102081	Shellpot Creek	Shellpot Creek @ Carr Rd.	64	-0.041	98	62	--	--	64	0	--
103011	Red Clay Creek	Stanton, Rt. 4 at Stanton Bridge (USGS gage 01480015)	115	--	--	114	-0.006	95	115	-0.1105	--
103031	Red Clay Creek	Red Clay Creek @ Lancaster Pike (Rt. 48)	142	--	--	141	-0.005	95	142	-0.0978	90
103041	Red Clay Creek	Red Clay Creek @ Barley Mill Rd. (Rd. 258A)	115	--	--	114	-0.010	95	115	-0.2505	98
103061	Red Clay Creek	Burroughs Run @ Creek Rd. (Rt. 82)	115	-0.017	90	114	--	--	116	-0.1187	98
104011	Brandywine Creek	Brandywine Creek @ Foot Bridge in Brandywine Park	114	--	--	113	-0.002	90	114	-0.0694	--
104021	Brandywine Creek	Brandywine Creek @ New Bridge Rd. (Rd. 279)	143	-0.019	95	142	--	--	143	0	--

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
104051	Brandywine Creek	Brandywine Creek @ Smith Bridge Rd. (Rd. 221)	113	--	--	111	--	--	113	-0.2003	95
105031	White Clay Creek	White Clay Creek @ Chambers Rock Rd. (Rd. 329)	114	--	--	113	-0.005	95	115	-0.3199	98
105151	White Clay Creek	White Clay Creek @ Delaware Park Blvd.	144	--	--	142	-0.002	90	144	-0.0949	--
105171	White Clay Creek	White Clay Creek @ McKees Lane	96	--	--	94	--	--	96	-0.2606	--
106021	Christina River	Christina River beneath Rt. 141 Bridge	105	-0.046	95	105	--	--	105	-0.5993	95
106031	Christina River	Smalleys Dam Spillway @ Smalleys Dam Rd.	108	--	--	106	--	--	108	-0.1913	--
106141	Christina River	Christina River @ Sunset Lake Rd. (Rt. 72)	135	-0.046	98	132	--	--	135	-0.3515	98
106191	Christina River	Christina River @ Nottingham Rd. (Rt. 273)	108	--	--	103	--	--	108	0	--
106281	Christina River	Little Mill Creek @ DuPont Rd.	108	-0.049	95	104	--	--	108	-0.2813	98
106291	Christina River	Christina River near Conrail Bridge	124	-0.030	95	124	-0.001	90	124	-0.3691	--
107011	Red Lion Creek	Red Lion Creek @ Bear Corbitt Rd. (Rt. 7)	105	-0.027	98	104	--	--	105	-0.1792	98
107031	Red Lion Creek	Red Lion Creek @ Rt. 9	103	--	--	102	0.004	95	103	-0.5605	--
108021	Chesapeake & Delaware Canal	C & D Canal @ DuPont Pkwy. (Rt. 13) N. side	102	--	--	101	--	--	102	0.5151	--

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
108111	Chesapeake & Delaware Canal	Lums Pond @ Boat Ramp	97	-0.023	95	108	--	--	--	--	--
109041	Appoquinimink River	Appoquinimink River @ DuPont Pkwy. (Rt. 13)	101	-0.051	95	103	--	--	104	-0.1259	--
109071	Appoquinimink River	Drawyer Creek off Rt. 13 @ parking area	103	-0.047	95	103	--	--	104	-0.8321	--
109091	Appoquinimink River	Appoquinimink River @ Mouth	104	-0.022	95	103	--	--	104	0.111	--
109121	Appoquinimink River	Appoquinimink River @ Silver Run Rd. (Rt. 9) NE	103	-0.026	95	102	-0.002	80	103	-1.217	95
109131	Appoquinimink River	Noxontown Pond @ Noxontown Rd. (Rd. 38)	96	-0.020	90	102	-0.001	90	104	-0.1677	--
109171	Appoquinimink River	Appoquinimink River @ MOT Gut (west bank)	94	-0.022	95	95	--	--	96	-0.1207	--
109191	Appoquinimink River	Shallcross Lake @ Shallcross Lake Rd. (Rd. 428)	103	-0.073	95	101	--	--	103	0	--
109251	Appoquinimink River	Deep Creek Branch @ Summit Bridge Rd. (Rt. 71)	86	-0.222	98	84	--	--	85	0	--
110011	Appoquinimink River	Blackbird Creek @ Blackbird Station Rd. (Rd. 463)	95	-0.028	90	97	--	--	98	0	--
110031	Lower Blackbird	Blackbird Creek @ Blackbird Landing Rd. (Rd. 455)	60	--	--	66	0.005	90	66	-0.4215	--
110041	Lower Blackbird	Blackbird Creek @ Taylors Bridge Rd. (Rt. 9)	101	-0.040	95	99	--	--	101	-0.8024	--

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
111011	Dragon Run Creek	Dragon Creek @ Wrangle Hill Rd. (Rt. 9)	91	--	--	104	0.003	95	--	--	--
111031	Dragon Run Creek	Dragon Creek @ S. DuPont Hwy. (Rt. 13)	99	-0.041	95	98	--	--	--	--	--
112021	Chesapeake Drainage System	Sewell Branch @ Sewell Branch Rd. (Rd. 95)	97	-0.062	95	102	--	--	101	0	--
114011	Army Creek	Army Creek @ River Rd. (Rt. 9)	97	-0.059	98	98	0.003	90	99	1.282	98
201011	Smyrna River	Mill Creek (Lake Como outfall) @ Rt. 13	57	--	--	68	--	--	68	-0.6384	95
201021	Smyrna River	Mill Creek @ Carter Rd. (Rd. 137)	96	-0.048	95	101	--	--	103	0	--
201041	Smyrna River	Smyrna River @ Flemings Landing (Rt. 9)	104	-0.028	95	102	--	--	104	-2.199	90
201051	Smyrna River	DucK Creek @ Smyrna Landing Rd. (Rd. 485)	96	--	--	102	--	--	104	0.348	--
201161	Smyrna River	Providence Creek @ Duck Creek Rd. (Rt. 15)	99	--	--	94	--	--	99	-0.2022	95
202021	Leipsic River	Garrisons Lake @ DuPont Hwy. (Rt. 13)	87	-0.027	80	102	--	--	--	--	--
202031	Leipsic River	Leipsic River @ Denny St. (Rt. 9)	102	-0.033	95	102	--	--	--	--	--
202191	Leipsic River	Leipsic River @ Mt. Friendship Rd. (Rt. 15)	60	-0.095	98	62	-0.004	90	62	-0.2735	--
204031	Little River	Little River @ Bayside Dr. (Rt. 9)	104	-0.043	98	103	--	--	104	0.7003	--

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
204041	Little River	Little River @ N. Little Creek Rd. (Rt. 8)	105	--	--	104	--	--	105	-0.2628	--
205011	Saint Jones River	St. Jones River @ mouth, Bowers Beach	79	-0.076	98	80	--	--	82	-0.5981	--
205041	Saint Jones River	St. Jones River @ Barkers Landing	105	-0.025	95	104	--	--	101	-2.113	95
205091	Saint Jones River	St. Jones River @ East Lebanon Rd. (Rt. 10)	100	-0.067	95	101	--	--	101	-1.491	98
205151	Saint Jones River	Fork Branch @ State College Rd. (Rd. 69)	92	-0.021	90	99	-0.003	80	99	-0.2912	98
205181	Saint Jones River	Moores Lake @ S. State St. (Rd. 27)	100	--	--	101	0.001	95	101	-0.126	--
205191	Saint Jones River	Silver Lake @ Spillway (Dover City Park)	104	--	--	128	0.001	80	129	-0.1408	--
205211	Saint Jones River	Derby Pond @ Boat Ramp (Rt. 13A)	94	--	--	99	0.001	95	99	0	--
206011	Murderkill River	Murderkill River @ Rt. 13	168	--	--	165	--	--	168	-0.1614	95
206041	Murderkill River	Browns Branch @ Milford-Harrington Hwy. (Rt. 14)	138	-0.219	98	136	--	--	138	-0.2408	98
206091	Murderkill River	Murderkill River @ Bay Rd. (Rt. 1/113)	134	-0.028	80	132	-0.005	95	134	-1.705	95
206101	Murderkill River	Murderkill River @ Bowers Beach Wharf (mouth)	148	-0.020	80	153	--	--	153	-2.484	95
206141	Murderkill River	Murderkill River near levee @ MNWA (RM 3.25)	124	--	--	123	-0.007	98	124	-1.906	95

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
206231	Murderkill River	Murderkill Rv. @ confl. of KCWWTF discharge ditch	123	-0.038	90	121	-0.006	80	123	-1.594	95
206361	Murderkill River	McColley Pond @ Canterbury Rd. (Rt. 15)	138	--	--	136	0.001	95	138	0	--
206451	Murderkill River	Coursey Pond @ Canterbury Rd. (Rt. 15)	129	0.031	80	134	--	--	136	-0.4087	95
206561	Murderkill River	Double Run @ Barratts Chapel Rd. (Rd. 371)	135	-0.080	95	134	0.002	90	135	0.4632	80
207021	Choptank	Cow Marsh Creek @ Mahan Corner Rd. (Rd. 208)	99	--	--	99	0.001	90	99	0	--
207081	Choptank	Tappahanna Ditch @ Sandy Bend Rd. (Rd. 222)	98	-0.020	80	101	0.002	80	101	0	--
207091	Choptank	Culbreth Marsh Ditch @ Shady Bridge Rd. (Rd. 210)	102	0.031	95	102	--	--	102	-0.0905	--
207111	Choptank	White Marsh Br. @ Cedar Grove Church Rd. (Rd. 268)	100	0.100	98	100	--	--	100	-0.0412	80
208021	Mispillion River	Mispillion River @ Rt. 1	107	--	--	106	-0.171	80	107	-1.134	95
208061	Mispillion River	Mispillion River @ Cedar Creek confluence	103	-0.036	95	110	--	--	110	-1.485	80
208181	Mispillion River	Abbotts Pond @ Abbotts Pond Rd. (Rd. 620)	109	--	--	104	--	--	108	0	--
208211	Mispillion River	Silver Lake @ Maple Ave.	108	--	--	107	--	--	109	-0.3279	95

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
208231	Mispillion River	Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	110	0.053	98	106	--	--	109	-0.237	95
301021	Cedar Creek	Swiggetts Pond @ Cedar Creek Rd. (Rt. 30)	108	0.031	80	104	--	--	107	-0.1727	95
301031	Cedar Creek	Cedar Creek @ Coastal Hwy. (Rt. 1)	110	--	--	109	0.004	95	109	0.3437	--
301091	Cedar Creek	Cedar Creek @ Cedar Beach Rd. (Rt. 36)	108	-0.031	95	106	--	--	109	-0.8542	--
302031	Marshyhope Creek	Marshyhope Creek @ Fishers Bridge Rd. (Rd. 308)	185	--	--	185	--	--	186	0	--
303011	Broadkill River	Savannah Ditch @ Savannah Drive (Rd. 246)	103	-0.416	90	102	--	--	102	0	--
303021	Broadkill River	Ingram Branch @ Gravel Hill Rd. (Rd. 248)	104	0.154	80	103	0.015	95	--	--	--
303031	Broadkill River	Broadkill River @ Union St (Rt. 5)	136	-0.063	95	133	--	--	135	0	--
303041	Broadkill River	Broadkill River @ Rt. 1 Bridge	104	-0.058	95	103	0.002	80	103	-0.792	--
303051	Broadkill River	Red Mill Pond @ Rt. 1	96	--	--	103	-0.003	95	103	-0.7305	95
303061	Broadkill River	Broadkill River 0.10 Miles From Mouth	81	--	--	85	--	--	87	0	--
303171	Broadkill River	Beaverdam Creek @ Cave Neck Rd. (Rd. 88)	105	--	--	103	-0.003	95	104	0	--
303181	Broadkill River	Beaverdam Creek @ Carpenter Rd. (Rd. 259)	103	-0.266	98	100	-0.010	95	102	-0.3657	98

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
303311	Broadkill River	Round Pole Branch @ Cave Neck Rd. (Rd. 88)	103	0.044	80	101	--	--	102	0	--
303331	Broadkill River	Waples Pond @ Rt. 1	105	--	--	101	--	--	104	0	--
303341	Broadkill River	Pemberton Branch @ Gravel Hill Rd. (Rt. 30)	104	0.051	98	99	--	--	103	-0.2019	95
304011	Nanticoke River	Nanticoke River @ Sharptown	94	--	--	93	--	--	95	0	--
304151	Nanticoke River	Nanticoke River @ Buoy 66 (mouth of DuPont Gut)	97	-0.038	95	95	--	--	97	-0.216	--
304191	Nanticoke River	Nanticoke River @ Rifle Range Rd. (Rd. 545)	183	--	--	181	--	--	183	-0.1827	98
304311	Nanticoke River	Concord Pond @ German Rd. (Rd. 516)	104	--	--	101	--	--	104	0	--
304321	Nanticoke River	Williams Pond @ East Poplar St.	101	-0.063	80	100	--	--	102	0	--
304381	Nanticoke River	Bucks Branch @ Conrail Rd. (Rd. 546)	91	--	--	90	--	--	91	0	--
304471	Nanticoke River	Nanticoke River @ Rt. 13	102	--	--	100	--	--	102	0.2111	--
304591	Nanticoke River	Deep Creek @ Old Furnace Rd. (Rd. 46)				43	-0.007	90	43	1.162	98
304681	Nanticoke River	Nanticoke River @ Beach Hwy. (Rt. 16)	49	--	--	49	--	--	49	-0.2804	--
305011	Lewes and Rehoboth Canal	Lewes & Rehoboth Canal @ Rt. 1	105	--	--	104	--	--	106	-0.8797	98
305041	Lewes and Rehoboth Canal	Lewes & Rehoboth Canal @ Rt. 9	104	--	--	104	--	--	106	-0.6095	95

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
306091	Rehoboth Bay	Rehoboth Bay @ Buoy 7	80	-0.015	98	95	--	--	97	-0.8721	98
306111	Rehoboth Bay	Massey Ditch @ Buoy 17	87	--	--	104	0.001	90	106	-0.9137	98
306121	Indian River	Indian River Bay @ Buoy 20	102	--	--	116	0.002	95	119	-0.8166	95
306181	Indian River	Indian River @ Buoy 49 (Swan Creek)	95	-0.054	95	95	--	--	97	0.3747	--
306321	Indian River	Indian River Inlet @ Coast Guard Station	114	-0.016	98	123	--	--	125	-0.2767	--
306331	Indian River	Indian River @ Island Creek	96	-0.032	95	94	--	--	96	-0.6217	80
306341	Indian River	Island Creek upper third	95	--	--	93	--	--	95	-0.6645	80
307011	Broad Creek	Records Pond @ Willow Street	103	-0.045	95	101	0.001	90	103	0	--
307031	Broad Creek	Broad Creek @ Bethel Rd. (Rd. 493)	47	0.157	80	47	0.005	95	47	2.607	95
307081	Broad Creek	Hitch Pond Branch @ Pepper Pond Rd. (Rd. 449)	44	--	--	49	--	--	49	0.2381	--
307171	Broad Creek	Horsey Pond @ Sharptown Rd. (Rt. 24)	98	-0.076	90	98	--	--	100	0	--
307371	Broad Creek	Raccoon Prong @ Pepperbox Rd. (Rd. 66)	62	--	--	66	--	--	65	0	--
308031	Rehoboth Bay	Burton Pond @ John Williams Hwy. (Rt. 24)	104	--	--	104	--	--	107	0	--
308051	Rehoboth Bay	Guinea Creek @ Banks Rd. (Rd. 298)	107	-0.104	95	104	0.001	80	107	-0.2523	80

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
308071	Indian River	Millsboro Pond @ John Williams Hwy. (Rt. 24)	143	-0.067	95	141	0.001	98	143	0.06214	90
308091	Indian River	Pepper Creek @ Main St. (Rt. 26)	109	-0.050	95	107	0.001	95	109	0.1428	--
308281	Indian River	Cow Bridge Branch @ Zoar Rd. (Rd. 48)	103	-0.076	95	107	0.001	90	108	0	--
308341	Indian River	Swan Creek @ Mount Joy Rd. (Rd. 297)	103	--	--	96	--	--	103	0	--
308361	Indian River	Blackwater Creek @ Omar Rd. (Rd. 54)	97	-0.133	95	97	--	--	99	-0.099	--
308371	Rehoboth Bay	Bundicks Branch @ Beaver Dam Rd. (Rt. 23)	94	0.212	95	94	--	--	94	-0.1164	80
309041	Iron Branch	Whartons Branch @ Dagsboro Rd. (Rt. 20)	107	-0.106	95	106	-0.001	95	107	-0.4364	95
310011	Little Assawoman Bay	Little Assawoman Bay @ Rt. 54 (The Ditch)	94	-0.023	95	106	--	--	109	-0.8528	95
310031	Little Assawoman Bay	Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	100	-0.068	95	105	--	--	107	-0.9807	95
310071	Little Assawoman Bay	Little Assawoman Bay Mid-Bay (Ocean Park Lane)	98	-0.049	95	105	-0.002	95	108	-1.281	95
310121	Little Assawoman Bay	Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	124	-0.143	95	121	0.001	90	124	-0.1183	80
311041	Buntings Branch	Buntings Branch @ Fenwick Rd. (Rt. 54)	99	--	--	99	--	--	100	0	--
312011	Indian River	White Creek @ mouth of Assawoman Canal	103	-0.041	98	106	-0.002	95	108	-1.398	95

Station	Watershed	Station Location	Total N count	Total N Trend	Total N Confidence	Total P Count	Total P trend	Total P Confidence	TSS Count	TSS Trend	TSS Confidence
313011	Pocomoke River	Pocomoke River @ Bethel Rd. (Rd. 419)	97	--	--	101	--	--	101	0	--
316011	Nanticoke River	Gravelly Branch @ Coverdale Rd. (Rd. 525)	106	--	--	101	--	--	106	0	--
316031	Nanticoke River	Gravelly Branch @ Deer Forest Rd. (Rd. 565)	53	-0.036	80	53	--	--	53	-0.0384	--
401011	Delaware Bay	Roosevelt Inlet Mouth	99	--	--	109	--	--	--	--	--

2016
Delaware Nonpoint Source Program
Department of Natural Resources and Environmental Control